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Echocardiographic profile of endomyocardial fibrosis in Tanzania, East Africa

EE MARO, M JANABI

Abstract

Objectives: To demonstrate and evaluate the usefulness of two dimensional and Doppler echocardiography in the diagnosis of endomyocardial fibrosis (EMF) in countries with poor resources. Also to evaluate the clinical assessment as a predictor of echocardiographically proven EMF.
Design: Descriptive hospital based study.
Setting: Muhimbili National Hospital, Dar es Salaam, Tanzania.
Subjects: 39 patients (27 male and 12 female, mean age 13.5 years) attending our Cardiac Clinic were investigated to determine the extent to which specific features could be diagnosed by transthoracic echocardiography.
Main Outcome Measures: Identifying and characterizing echocardiographic features specific for diagnosing EMF non-invasively.
Results: Only eight (21%) patients had a correct clinical diagnosis, leaving 79% of the patients at risk of being misdiagnosed and hence wrongly receiving expensive treatment. The majority of the patients (69.2%) presented with signs of elevated systemic venous pressure due to right ventricular EMF.
Conclusion: We have demonstrated that echocardiography remains a fundamental investigation in the least developed countries in achieving the correct diagnosis.

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Introduction

Endomyocardial fibrosis (EMF) is endemic in parts of Africa, South and Central America, and Asia, and occurs sporadically throughout the world.[1-3] A few cases have been reported in Caucasians in temperate climates rarely in the absence of prior residence in tropical countries.[4] This disease, which was first described by Davies *et al.*[5] is essentially restrictive ardiomyopathy characterized by EMF or thickening, usually involving the apex and outflow tracts of one or both ventricles.

The causes of EMF remain unknown. Several aetiologic factors have been suggested, including parasitic infections or hyper reaction to malaria, filariasis and *streptococcus*, viral myocarditis, malnutrition and cation imbalance.[1,5,6,7] In sub-Sahara Africa, where the disease is most prevalent, the typical diet is high in a tuber called cassava, which contains high concentrations of a rare element cerium (Ce). The combination of high cerium levels and hypomagnesemia has been shown to produce EMF-like lesions in laboratory animals.[8] Rarely a familial tendency has been noted in some parts of Africa such as Uganda and Zambia.[9]

The medical treatment of EMF is often difficult and not particularly effective in patients with advanced disease. The overall prognosis in these patients is poor and depends on the degree and location of involvement within the heart.[10] Typically, the disease has an insidious onset, with development of increasing severe right and left-sided heart failure. Sudden death or syncopal episodes are not as common in EMF as they are in other causes of restrictive cardiomyopathy. However, atrial fibrillation does occur and is more frequent in patients with right ventricular disease.[11] Digitalis glycosides may be helpful in controlling the ventricular rate in patients with atrial fibrillation but the response of congestive symptoms is disappointing. Diuretics are not particularly helpful in the treatment of ascites. Surgical excision (decorticating) of the fibrotic endocardium and replacement of the mitral and/or tricuspid valve have lead to substantial symptomatic improvement.[12,13] Operative mortality has been high, running between 15 and 25% in the larger series.[10,12,13] The

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importance of establishing *ante mortem* diagnosis of EMF is to rule out surgically correctable causes of restrictive heart disease, especially constrictive pericarditis, which is common in the tropics due to mycobacterium tuberculosis infections. With this background, the purpose of this study was to describe our experience with 39 cases of EMF diagnosed using the transthoracic echocardiography technique and to determine and emphasize the extent to which specific features of this disease could be recognized by this method.

Materials and Methods

Following the introduction of an echocardiography machine at Muhimbili National Hospital in 1991, patients from all regions of the country with complex cardiac lesions were referred to our hospital for further evaluation and treatment. From May 1992 to April 1999, 6 336 patients were referred to our Cardiac Clinic for further evaluation. Four cardiologists evaluated these patients and concluded the clinical diagnosis before echocardiography examination. The echocardiography examinations were done by two cardiologists. Among 6 336 patients, 39 (0.62%) patients were found to have EMF echocardiographically. These patients, who were of African origin, were studied consecutively and prospectively. Their echocardiography tapes were reviewed by another cardiologist who didn't do the echocardiography examination. All subjects gave written informed consent to participate in this study, and the hospital ethical committee approved the study protocol. The clinical presentation and routine laboratory data, including total and differential white blood cell counts, were done in all patients diagnosed as having EMF. Electrocardiography and chest X-ray studies were also done.

M-mode, two dimensional echocardiography, Doppler and colour flow mapping were performed in all patients using a Sonos 1 000 Hewlet Packard Machine with 2.25 to 7.0 MHZ transducers. All the standard positions i.e. measurements of the cavities and walls of the heart were performed as recommended by the American Society of Echocardiography.[14] Mitral and tricuspid velocities were recorded from the apical window with pulse wave Doppler. To obtain this, approximately 2 to 3mm sample volume was placed between the edges of mitral and tricuspid leaflets during diastole phase. We measured the peak velocity of early diastolic filling (E wave) and late filling atrial contraction (A wave) and deceleration time of the E wave of both the mitral and tricuspid valves. Continuous wave and colour Doppler echocardiography were used to determine the presence and grading of mitral and tricuspid regurgitations. We further determined the percentage of difference of the peak tricuspid incompetence velocities between inspiration and expiration. We calculated right systolic pressure from tricuspid incompetence velocity by using the Bernoulli formula.[14] Pulmonary veins were observed from the transthoracic window. All recordings were done using a Sanyo Video recorder. We used the echocardiographic criteria established previously to diagnose endomyocardial fibrosis.[1,5,7] Due to unavailability of facilities at the hospital, angiography was not performed.

All variables are presented as percentages. The difference between the inspiratory and expiratory mitral and tricuspid measurements was calculated as a percentage of increase relative to inspiration.

Results

From May 1992 to April 1999, EMF was diagnosed in 39 of 6 336 patients who had echocardiographic examination at Muhimbili National Hospital. Among the 39 patients, 27 were male and 12 female, a M:F ratio of 2:1. The mean age of these patients was 13.5 years (range six to 57 years).

Table I shows the initial clinical diagnoses of the 39 patients with EMF before echocardiography was done. Only eight (20.51%) patients had a correct diagnosis of EMF. Twelve (30.77%) patients had a diagnosis of dilated cardiomyopathy and seven (17.95%) had a diagnosis of pericardial effusion due to tuberculosis. Three patients who had clinical diagnoses of EMF were later found to have constrictive pericarditis using echocardiography.

Table I: Clinical diagonoses of the 39 patients with EMF.

Diagnosis	No. of Patients	%
Dilated cardiomyopathy	12	30.77
Endomyocardial fibrosis	8	20.51
Pericardial effusion	7	17.95
Mitral valve disease	5	12.82
Constructive pericarditis	5	12.82
Ebstein anomaly	1	2.55
Atrial myxoma	1	2.55

Table II shows the symptoms complained of by the 39 patients with EMF. The most common symptom was abdominal swelling followed by facial swelling. Ankle swelling prevalence was 35.9%. Ankle swelling was either absent or minimal; consequently the legs were thin and together with the massive ascites, gave an "egg on stick" appearance in 14 patients.

Table II: Symptoms of the 39 patients with EMF.

Symptom	Prevalence (%)
Abdominal swelling	79.5
Facial swelling	76.9
Breathlessness	66.7
Cough	66.7
Palpitations	41.0
Chest tightness	38.5
Ankle swelling	35.9
Fatigue	35.9
Jaundice	23.1
Abdominal pain	17.9
Loss of weight	10.3
Protruding eyes	10.3

Table III shows the physical signs observed in the 39 patients with EMF. EMF may affect either or both ventricles. The majority of our patients had right ventricular EMF. The common cardiac signs were raised angular venous pressure, feeble peripheral pulses and muffled heart sounds. The common extracardiac signs were ascites, hepatomegoly and growth retardation.

Table IIIa: Cardiac signs observed in 39 patients with EMF.

Sign	Prevalence (%)
Raised jugular venous pressure	89.7
Feeble peripheral pulse	84.7
Muffled heart sounds	69.2
Precordial heave	51.3
Tricuspid regurgitation murmur	51.3
Third hear sound	41.0
Atrial fibrillation	25.6
Mitral regurgitaion murmur	15.4

Table IIIb: Extracardiac signs observed in 39 patients with EMF.

Sign	Prevalence (%)
Ascites	84.7
Hepatomegaly	84.6
Growth retardation	58.9
Pedal oedema	46.2
Basal crackles	41.0
Splenomegaly	20.5
Proptosis	15.4
Jaundice	15.4
Central cyanosis	10.3
Digital clubbing	10.3

Table IV shows the echocardiographic findings in 39 patients with EMF. Both the four chamber apical, parasternal and subcostal views were used to assess the atria and the ventricles. Among the 39 patients proven to have EMF using echocardiography, 27 (69.23%) patients had right-sided EMF, while six (15.38%) patients had biventricular EMF. In all cases of right-sided EMF, the right atria were enlarged (ranging from 4.7 to 10 cm (mean 6.5cm). Three (7.69%) patients had right atria thrombi with no signs of embolization to the lungs.

Table IV: Echocardiographic findings in 39 patients with EMF.

Finding	No. of Patients	%
Right ventricular EMF	27	69.23
Biventricular EMF	6	15.38
Left vetnricular EMF	4	10.26
Septal EMF	2	5.13
Pericardial effusion	14	35.89
Moderate to severe Tricuspid regurgitation (Grade 3 and 4)	21	53.85
Right artial thrombus	3	7.69

Discussion

EMF is not observed in children younger than four years. Those most commonly affected are older children (five to 15 years) and young adults, but a case has been reported in an individual aged 70 years.[8] In Nigeria, 50% of the patients were less than 15 years and 70% were under 20 years.[2] The age incidence in other African countries is similar. A slight female predilection has been observed in Uganda, where as in Nigeria and Ivory Coast, EMF affects more males than females.[2] In our study, the mean age of our patients was 13.5 years (range six to 57 years). We found more males than females affected, supporting previous findings.

The diagnosis of EMF in Tanzania, has hitherto been mainly clinical, until 1991 when echocardiography was introduced in our national hospital. Even to date echocardiography equipment, technicians or doctors who can perform it, are limited to big urban government and private hospitals, making clinical diagnosis still an important tool. The commonly available means of investigation such as the electrocardiogram and chest roentgenograms are helpful but not specific, neither sensitive, for the diagnosis of EMF. In developed countries angiography has been for many years one of the main tools for the diagnosis of EMF.[13,15] However, echocardiography has been shown to be useful and precise in making the diagnosis of EMF.[8] Thus with echocardiography, it is possible non-invasively to differentiate EMF from other conditions which clinically mimic EMF, such as constrictive pericarditis, dilated cardiomyopathy, mitral valve disease, Ebstein anomaly and atrial myxoma.[16] Our assumption that echocardiography is more beneficial than physical examination *per se* was reinforced by the fact that in this study only eight (21%) patients had a correct clinical diagnosis, leaving 79% at risk of being misdiagnosed and incorrect expensive treatment instituted.

The symptoms and signs of patients with EMF varied according to the stage and severity of the disease, as well as to the side of the chamber affected. Left-sided involvement results in symptoms of pulmonary congestion i.e. clinical findings often resemble those of mitral valve disease, while predominant right-sided disease may show markedly elevated systemic venous pressure and tricuspid regurgitation. In our study, the majority of the patients (69.23%) had right ventricular EMF with marked elevation of systemic venous pressure. This observation supports the previous studies which had similar phenomenon.[11,17]

Contrary to one *post portem*[18] finding of combined right ventricular and left ventricular disease, in 50% of cases, pure left ventricular in 40% and pure right ventricular disease in the remaining 10% of their patients, we found the reverse. In our study, 27 (69.23%) patients had right ventricular disease, six (15.38%) patients had biventricular, four (10.26%) left ventricular and two (5.13%) patients had septal disease. No obvious reason could explain these findings. However, these results led us to seriously consider the possibility of geographical variation in the chamber(s) affected by EMF. Further studies to clarify this are underway.

The common findings on right ventricular EMF were, aneurismal right atrium, dilatation of the right ventricular outflow tract, dense fibrous tissue obliterating the apex of the right ventricle and paradoxical interventricular septal motion. In left ventricular EMF, the left atrium dilated with plastered down posterior mitral valve leaflet, patchy enhancement of the endocardial echo and obliteration of the left ventricle apex with evidence of endocardial calcification. Right atrial thrombi occurs commonly in EMF[3, 18] and major systemic or pulmonary embolism is uncommon.[19] In our study three (7.69%) patients had right atria thrombus and none had signs of embolication to the lungs.

In considering the significance of our findings, several vital limitations must be kept in mind. While our study adds to the body of evidence of the general presentation of EMF in Africa, we are aware that echocardiography is not the most accurate diagnostic tool for endomyocardial fibrosis in this era of cut edge science. However, in our least developed countries, it provides the opportunity for a better diagnosis and give us the general picture of EMF. Recently it has been shown that transoesophageal echocardiography is more informative in EMF patients with an unsuitable acoustic window. It is more accurate than the transthoracic approach in the study of pulmonary veins and severity of mitral regurgitation. This was not done due to lack of these facilities. Lastly, due to inadequate documentation and various economic reasons the majority of patients could not turn up on appointment dates for follow up. This made the follow up data difficult to analyse properly and hence the drawing of correct conclusions. Putting all together, the ministries involved should allocate more funds to purchase diagnostic equipment, train more staff and organize a multicentre, multidisciplinary, well structured approach to diagnose and care for EMF patients. This is essential if we need to combat this debilitating condition in our African continent.

Conclusion

EMF occurs in Tanzania, as in many other tropical countries and the disease affects children and young adults. It is anticipated that echocardiography will continue to play an important role in the identification of EMF, at least in the developing countries, for years to come. As shown, patients having this pathology share common characteristic diagnostic signs and echocardiography pattern.

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